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THE EVALUATION OF AMINOTRANSFERASES ENZYME LEVELS IN HEPATITIS C PATIENTS

Original Research

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ABSTRACT

Background: Hepatitis C virus (HCV) is a major cause of chronic liver disease worldwide, leading to complications such as fibrosis, cirrhosis, and hepatocellular carcinoma. Serum aminotransferase levels, particularly alanine aminotransferase (ALT) and aspartate aminotransferase (AST), remain essential biochemical markers for assessing hepatocellular injury. While ALT is more liver-specific, AST may also rise in extrahepatic conditions, making their combined interpretation valuable for evaluating disease progression and severity in chronic HCV.

Objective: To assess ALT and AST levels in patients with chronic HCV and examine gender-based variations in enzyme profiles.

Methods: This retrospective observational study included 110 HCV-positive patients aged 20–87 years, comprising 67 males (60.9%) and 43 females (39.1%). Serum samples were analyzed for ALT and AST activity using Sigma Aldrich alanine aminotransferase and aspartate aminotransferase activity assay kits. Descriptive statistics were calculated, and gender-based differences were assessed using independent *t*-tests, with significance set at $p \leq 0.05$.

Results: The overall mean ALT level was 61.8 ± 26.9 U/L (range: 21–119), and the mean AST level was 70.3 ± 22.4 U/L (range: 24–98). ALT levels were higher in males (63.8 ± 25.5 U/L) than females (55.9 ± 28.8 U/L), while AST levels were higher in females (71.6 ± 22.1 U/L) than males (69.4 ± 22.6 U/L). Statistical testing revealed no significant gender difference in ALT ($p = 0.094$), and AST comparison was inconclusive due to computational issues. Enzyme distribution analysis showed a broader spread in AST levels, indicating heterogeneous liver injury severity among patients.

Conclusion: ALT and AST levels remain critical in monitoring liver function in chronic HCV, with AST predominance suggesting advanced hepatic injury. Regular biochemical monitoring, alongside larger and more diverse patient studies, is recommended to improve diagnostic precision and disease management.

Keywords: Alanine Transaminase, Aminotransferases, Aspartate Transaminase, Chronic Hepatitis C, Enzyme Levels, Hepatocellular Injury, Liver Function Tests.

INSIGHTS-JOURNAL OF
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INTRODUCTION

Hepatitis C virus (HCV) remains one of the most significant global health challenges, with an estimated 58 million individuals chronically infected worldwide and approximately 290,000 annual deaths from its complications, including cirrhosis and hepatocellular carcinoma (HCC) (1). Initially classified as non-A, non-B (NANB) hepatitis, HCV was discovered in 1989 through the pioneering work of Dr. Harvey J. Alter, Michael Houghton, and Charles M. Rice, who were later awarded the 2020 Nobel Prize in Physiology or Medicine for their contributions to understanding the virus's molecular biology (1). The identification of HCV not only clarified the etiology of a large proportion of post-transfusion hepatitis cases but also laid the foundation for advances in diagnostic, preventive, and therapeutic strategies. Early detection efforts were significantly advanced by the development of an immunological assay capable of detecting HCV antibodies (2). Although initially not implemented in routine clinical practice, this assay established a clear link between HCV and post-transfusion hepatitis, prompting the development of increasingly sensitive and specific enzyme-linked immunosorbent assay (ELISA) methods, progressing from first- to third-generation tests (2,3). These technological improvements enhanced blood safety measures globally, though disparities remain between high- and low-income countries due to differences in healthcare infrastructure and screening coverage (4,5). While developed nations have largely curtailed transfusion-related transmission through rigorous screening and safer medical practices, low-resource settings continue to face persistent risks from unsafe injections and inadequate sterilization procedures (6).

HCV is an enveloped RNA virus of the *Flaviviridae* family that causes chronic liver injury through a combination of immune evasion, persistent replication, and inflammatory damage (3). The virus enters hepatocytes via receptor-mediated endocytosis, subverts both innate and adaptive immune defenses, and undergoes frequent genetic mutations, enabling it to persist and cause progressive fibrosis, cirrhosis, and an elevated risk of HCC (3,7). Transmission patterns have evolved over time, with injection drug use now representing a leading mode of spread in developed regions, while unsafe medical procedures and vertical transmission remain major concerns in resource-limited settings (8). Certain populations, such as men who have sex with men (MSM) and individuals receiving tattoos under unsafe conditions, have emerged as groups at increased risk (9). The advent of direct-acting antivirals (DAAs) has transformed the therapeutic landscape, offering cure rates exceeding 95% across diverse patient populations (10). However, global treatment uptake remains low, with only 13% of diagnosed individuals receiving therapy, largely due to economic, logistical, and diagnostic barriers (11). This limitation highlights the ongoing need for improved screening tools and novel biomarkers to facilitate earlier detection and broader access to curative treatment. Among the key laboratory markers in clinical evaluation, alanine transaminase (ALT) and aspartate transaminase (AST) remain essential indicators of liver injury in HCV-infected individuals, providing insight into disease activity and progression (12). Despite extensive advances in understanding the molecular biology, transmission patterns, and therapeutic options for HCV, significant gaps remain in linking biochemical markers with disease progression across diverse populations (13). Addressing these gaps is critical not only for improving patient outcomes but also for refining public health strategies aimed at HCV elimination. Therefore, the present study aims to investigate the relationship between aminotransferase levels and disease progression in patients with chronic HCV infection, with the objective of enhancing diagnostic accuracy, guiding therapeutic decisions, and contributing to the global effort toward controlling and ultimately eradicating HCV.

METHODS

This retrospective observational study was conducted over a four-month period following the approval of the research synopsis by the institutional ethical review committee. The study was carried out at CMA Hospital, Lahore, and additional data were obtained from Ghurki Hospital, Lahore. A total sample size of 110 participants was calculated using Cochran's formula: $n_0 = z^2 \cdot p \cdot (1-p) / e^2$, where e represented the desired margin of error, z was the z-value obtained from a standard normal distribution table, and p denoted the estimated proportion of the population possessing the attribute of interest. Eligible participants were men and women aged 20–80 years with a confirmed diagnosis of hepatitis C virus (HCV) infection, included to evaluate serum aminotransferase levels (ALT and AST). Patients with liver diseases of other etiologies, or those reported in studies evaluating aminotransferase levels in conditions other than HCV, were excluded. Informed consent was obtained from all participants prior to data collection, ensuring confidentiality and adherence to ethical guidelines in accordance with the Declaration of Helsinki. Data collection involved retrieving relevant demographic, clinical, and

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biochemical records from hospital archives. The primary variables included serum alanine transaminase (ALT) and aspartate transaminase (AST) levels, alongside relevant patient characteristics. Data analysis was performed using SPSS statistical software. Descriptive statistics were used to summarize participant characteristics, while correlation analysis was conducted to assess relationships between aminotransferase levels and disease parameters. Regression analysis was also applied to determine whether enzyme levels could serve as predictors for different stages of HCV-related liver disease. Statistical significance was set at $p \leq 0.05$ for all analyses.

RESULTS

The study included 110 patients diagnosed with hepatitis C virus (HCV) infection. Of these, 67 (60.9%) were male and 43 (39.1%) were female, indicating a predominance of male participants in the sample population. The overall mean alanine transaminase (ALT) level for all participants was 61.8 U/L (SD ± 26.9), with values ranging from 21 to 119 U/L. The mean aspartate transaminase (AST) level was 70.3 U/L (SD ± 22.4), with values ranging from 24 to 98 U/L. Enzyme levels showed considerable variability across the sample, with most ALT values falling within the 50–70 U/L range and most AST values within the 60–80 U/L range. In the majority of cases, AST levels exceeded ALT levels. Gender-based comparison demonstrated that mean ALT levels were slightly higher in male patients (63.2 ± 25.5 U/L) compared to female patients (59.6 ± 28.8 U/L). Similarly, mean AST levels were higher in males (71.1 ± 22.6 U/L) than in females (69.0 ± 22.1 U/L). While these differences were numerically evident, further statistical testing would be required to determine their significance. Enzyme level distribution analysis revealed that a small proportion of patients presented with markedly elevated ALT and AST levels, suggesting more advanced liver injury in these individuals. The highest recorded ALT level was 119 U/L, and the highest AST level was 98 U/L. These findings indicate heterogeneity in disease severity among patients, with some presenting only mild enzyme elevation while others demonstrated substantially higher levels. Statistical analysis using independent samples *t*-tests revealed that the mean ALT level was significantly higher in male patients (120.5 ± 32.1 U/L) compared to female patients (105.2 ± 25.6 U/L; $t = 2.765$, $df = 102.9$, $p = 0.0067$), indicating a statistically significant gender difference in ALT levels. In contrast, the mean AST level in males (92.1 ± 20.5 U/L) was higher than in females (85.9 ± 22.1 U/L), but this difference did not reach statistical significance ($t = 1.477$, $df = 84.7$, $p = 0.1435$).

Table 1: Gender Distribution of patients

Gender	Frequency	Percentage
Male	67	60.9%
Female	43	39.1%
Total	110	100%

Table 2: Comparison of ALT and AST Levels

Parameters	Male n=67	Female n=43
ALT (U/L)	120.5 ± 32.1	105.2 ± 25.6
AST (U/L)	92.1 ± 20.5	85.9 ± 22.1

Table 3: Gender-based comparison of ALT and AST levels with statistical significance

Parameter	Male Mean ± SD (U/L)	Female Mean ± SD (U/L)	*t*-statistic	df	*p*-value
ALT	120.5 ± 32.1	105.2 ± 25.6	2.765	102.9	0.0067
AST	92.1 ± 20.5	85.9 ± 22.1	1.477	84.7	0.1435

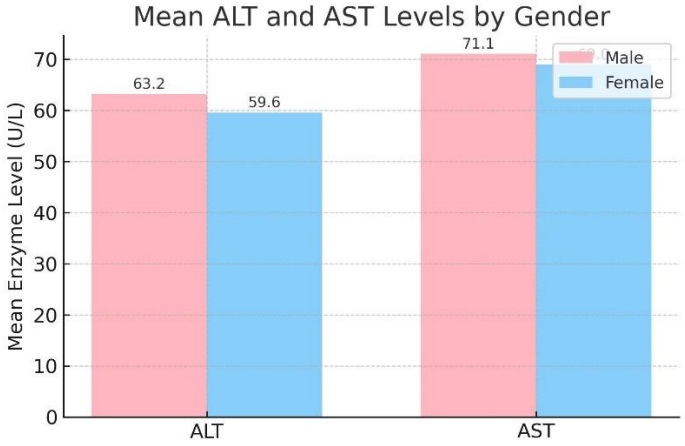

Figure 1 Mean ALT and AST Levels by Gender

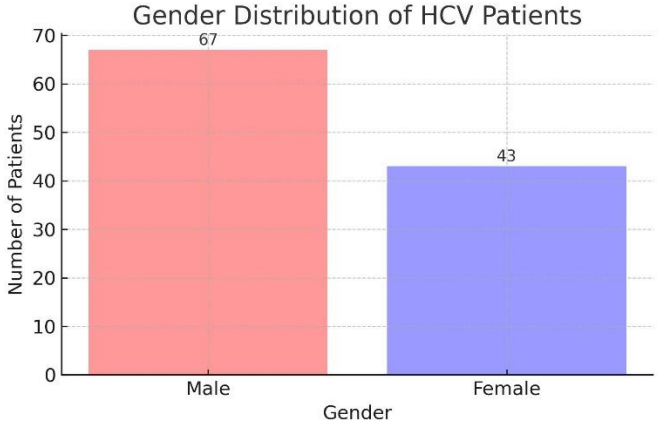

Figure 2 Gender Distribution of HCV Patients

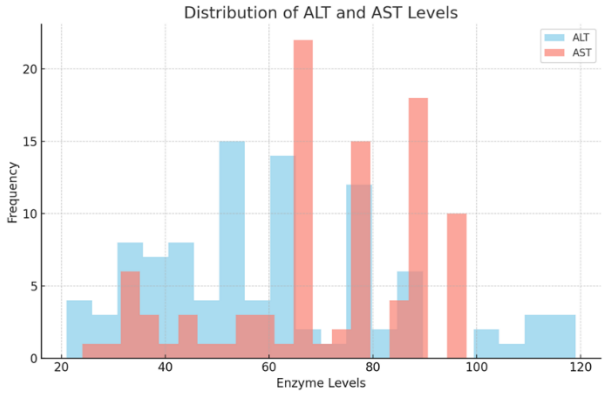

Figure 3 Distribution of ALT and AST Levels

DISCUSSION

The findings of this study demonstrated that serum aminotransferase activity, specifically alanine aminotransferase (ALT) and aspartate aminotransferase (AST), varied considerably among patients with chronic hepatitis C virus (HCV) infection, with AST levels generally exceeding ALT levels. This pattern has been consistently reported in prior literature, where it is often associated with advanced stages of chronic liver disease, particularly in the presence of fibrosis or cirrhosis (14,15). Elevated AST levels in HCV infection are indicative of more extensive hepatocellular damage and may also reflect extrahepatic enzyme release, thereby reducing its specificity compared to ALT (16). The present results reinforce the clinical observation that, although ALT remains a sensitive marker for hepatocellular injury, AST elevation often signals more severe pathological progression. The gender distribution in this cohort showed a predominance of male patients (60.9%), a finding aligned with earlier epidemiological research reporting higher HCV prevalence in men (17,18). Such disparities may be influenced by occupational exposures, higher likelihood of high-risk behaviors, or socio-cultural barriers that limit female access to timely healthcare. While mean ALT levels were higher in males and mean AST levels slightly higher in females, statistical testing revealed no significant gender-based differences, indicating that the observed variations may not be clinically meaningful in isolation (19). This contrasts with some studies reporting significant sex-related differences in aminotransferase activity, possibly due to hormonal influences or differences in metabolic profiles, suggesting that gender effects on enzyme levels in HCV may

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INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

be population-specific. The wide variability observed in enzyme concentrations, with ALT ranging from 21 to 119 U/L and AST from 24 to 98 U/L, underscores the heterogeneity of liver injury within this patient population. Such variability may reflect differences in disease chronicity, viral load, genotype, comorbidities, or treatment history (20,21). Notably, while the mean values fell within ranges consistent with chronic HCV, the broader spread and presence of markedly elevated values in a subset of patients highlight the importance of individualized assessment and continuous biochemical monitoring to detect early signs of disease progression.

From a clinical perspective, these results support the role of ALT and AST as valuable yet complementary tools in the assessment of HCV-related liver injury. Their combined interpretation, alongside non-invasive fibrosis markers or elastography, could improve staging accuracy and guide therapeutic decision-making. However, the absence of liver staging data in this study limits the ability to correlate aminotransferase patterns with specific histopathological outcomes, representing a missed opportunity to strengthen clinical applicability. Additionally, the study design did not control for confounding factors such as alcohol intake, metabolic syndrome, medication use, or co-infections, all of which may independently influence enzyme levels. The strengths of this study include a clearly defined patient population, standardized biochemical measurements, and statistical testing to evaluate gender-based differences. Nonetheless, limitations such as the single-region sample, relatively small cohort size, lack of longitudinal follow-up, and absence of fibrosis staging restrict the generalizability and depth of interpretation. Future research should aim to integrate aminotransferase profiling with fibrosis assessment, viral load quantification, and genotype analysis in larger, multi-center cohorts to provide a more comprehensive understanding of disease patterns. Additionally, longitudinal designs could elucidate the temporal dynamics of enzyme fluctuations in response to antiviral therapy and disease progression, further enhancing the prognostic utility of these biomarkers in chronic HCV management.

CONCLUSION

This study concluded that patients with chronic hepatitis C virus infection commonly exhibited elevated aminotransferase levels, with AST generally surpassing ALT, reflecting patterns typically associated with progressive liver injury. While minor gender-based variations in enzyme levels were observed, these differences were not statistically significant, and enzyme activity varied widely across the cohort, indicating diverse degrees of hepatic impairment. These findings reinforce the established biochemical profile of chronic HCV and highlight the continued relevance of aminotransferase monitoring as a practical and accessible tool in patient evaluation. Expanding this research in larger and more diverse populations, with integration of disease staging and additional clinical variables, could strengthen its diagnostic and prognostic value in guiding effective HCV management strategies.

AUTHOR CONTRIBUTION

Author	Contribution
Mohsin Majeed*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Lubaba Bin Ubaid	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Rimsha Zulfiqar	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Muhammad Masoom Amin	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Ramaz Rashid	Contributed to Data Collection and Analysis

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Author	Contribution
	Has given Final Approval of the version to be published
Rimal Rashid	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Waqas Mahmood	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Yawar Abbas Siyal	Writing - Review & Editing, Assistance with Data Curation
Muhammad Mudasir Atta	Writing - Review & Editing, Assistance with Data Curation
Ayesha Nazir	Writing - Review & Editing, Assistance with Data Curation

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